

A MUST HAVE GUIDE FOR ANY DRONE ENTHUSIAST



DRONE 101

MYIN UDDIN



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How the term 'Drone' came?

Surely you are not expecting me to say "A drone is a male honey bee's humming sound while flying" but it's true and you will be surprised to know that the term 'Drone' coined from this similarity of flying drone with flying bees sound. In 1935, British produced a number of radio-controlled aircraft and It's thought that the term 'drone' started to be used at this time, inspired by the name of one of these models, the **DH.82B Queen Bee**.

What is considered as Drone?

For answering this question, you need to know the technical definition of drone. In my sense below these three definitions are perfect for giving you an idea of what exactly is drone.

1. According to most of the dictionaries "A Drone is an unmanned aircraft or ship guided by remote control or onboard computers."
2. "A drone is a flying robot that can be remotely controlled or fly autonomously through software-controlled flight plans in their embedded systems, working in conjunction with onboard sensors and GPS."
3. "Unmanned aerial vehicles (UAVs) or Drones are aircraft with no on-board crew or passengers. They can be automated 'drones' or remotely piloted vehicles (RPVs)."

What is not a Drone?

As of now you know what is drone but you should also know what is not considered as a drone. To be brief I will just say remember that Drones are not Missiles. Most people are mistaken about it so keep in mind that any Cruise vehicles, Artillery Projectiles, Mines, Ballistic or Semi Ballistic vehicles, Torpedoes, Rocket and Satellites are not considered as Drone.

Basic characteristics of Drone:

- A drone is an unmanned Aircraft, a flying Robot and known as UAV or RPV.
- Drone can be completely Autonomous with the help of onboard software and FCB.
- Drones can be remotely controlled (RC) by Bi-directional radio wave.
- Most Drones works in conjunction with onboard sensors and GPS.
- Drone can have fixed wing, rotary wing or hybrid designs.
- Most drones have various kinds of Autonomy related features like Headless mode, Follow me, One key return etc.
- Drones can have fuel engines (Gas, turbine, wankle) and Battery as power supply.
- Drones can be as big as 61m wing span and can be as small as less than 1mm.
- Some drones are waterproof especially Underwater marine drones.
- Military drones can carry up to 3000kg payloads and fly as high as 60000 feet.



Drone

**DH82 Queen Bee
(mother of drones)**



The Beginning History

When it comes to aviation war worth it. World war 1 & 2 and cold war as well was the golden age of design and manufacturing newer and better manned, unmanned aircrafts throughout the world. You might not believe the first unmanned aerial vehicle was created almost 170 years ago. The history of drone is still in infancy. From exploding balloons to the unmanned flying taxi in this section we will let you know when everything originated at the very beginning. Get ready to travel the timeline of UAV milestones.

Historical Timeline:

- **1839:** The earliest UAV in the history of drones was seen in 1839, when Austrian soldiers attacked the city of Venice with unmanned balloons filled with explosives.
- **1896:** First use of UAV using camera for surveillance.
- **1907:** The world's first quadcopter was created by inventor brothers Jacques and Louis Bréguet.
- **1917:** The Ruston Proctor Aerial Target became the first pilotless winged aircraft in history. It was a radio-controlled pilotless airplane, based on RC technology from the inventor Nikola Tesla.
- **1943:** Created for use by the German military during World War II, "Fritz X" was the nickname given to the FX-1400, the first remote-controlled weapon that was actually put into operational use.
- **1960:** Boom in RC planes popularity in the U.S. Mostly coming in kit form, these RC planes offered everything from indoor-flyable models to much larger outdoor models.
- **1982:** Modern drone warfare began in 1982, when Israel coordinated the use of battlefield UAVs alongside manned aircraft to wipe out the Syrian fleet with very minimal losses.
- **1993:** Monitoring of climate and environment using drone begins.
- **2001:** In the aftermath of 9/11, the CIA began flying armed drones over Afghanistan as part of the war against the Taliban. The first CIA drone-based kill operation took place in February 2002.
- **2006:** Recognizing the potential of non-military, non-consumer drone applications, the FAA issued the first commercial drone permits.
- **2010:** The French company Parrot released their Parrot AR Drone, the first ready-to-fly drone which can be controlled entirely via Wi-Fi, using a smartphone.
- **2013:** In December 2013, Amazon released a concept video showcasing founder Jeff Bezos' dream for a drone-based delivery system.
- **2014:** General use of drone as toy started to introduced.
- **2016:** DJI's Phantom 4 introduced smart computer vision and machine learning technology in drone.
- **2016:** The first passenger drone was introduced at the Consumer Electronics Show (CES) 2016 by Chinese entrepreneurs and is called the Ehang 184.



Quick Facts:

1. Tesla becomes part of the history of drones with the tele-automaton or RC.
2. The inventor of the first drone was Austria, Franz von Uchatius.
3. Barely nine years after the first use of drones in Europe by the Austrians, the first communication by means of radio waves was achieved between Europe and America.
4. Around 40 000 aircraft and 80 000 crew members were lost during WW2. If an effective drone could be developed, it would be a huge financial and human bonus. No loss of human lives or airplanes was a massive and ambitious goal.
5. Abraham Karem is regarded as the founding father of UAV (drone) technology.

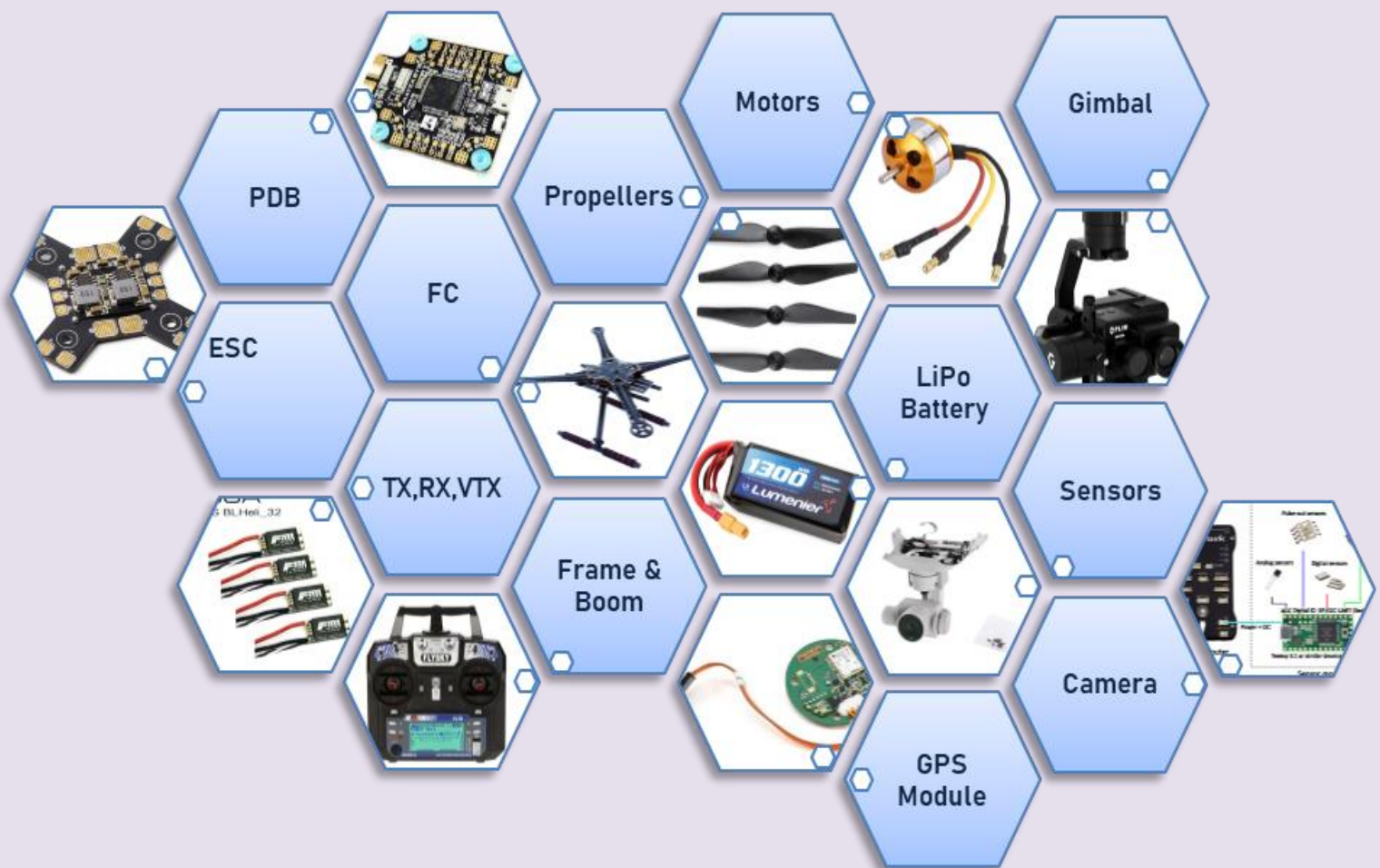
Abraham Karem: The founding father of UAV

Abraham Karem was born in Baghdad to a Jewish couple. His family moved to Israel in 1951, where he grew up. Since an early age, he had an innate passion for aeronautics, and at the age of 14, he started building model aircraft. Karem is regarded as the founding father of UAV (drone) technology. He graduated in aeronautical engineering from The Technion. He built his first drone during the Yom Kippur war for the Israeli Air Force. In the 1970s, he immigrated to the United States. He founded Leading Systems Inc. in his home garage, where he started manufacturing his first drone, Albatross, and later on, the more sophisticated Amber, which eventually evolved into the famous Predator drone, which brought him the title of "**Dronefather**".



Anatomy of Drone

No doubt, the exponential growth of drone industry will continue revolutionize our future decades. Surely you don't want to miss the chance of enjoin yourself with this evolving UAV field whether by being a drone pilot or who knows maybe by being a drone developer even. But before everything, I know you are here because you are very enthusiastic about drone so I urge you to have at least basic knowledge about major drone parts which are vital for every smooth and safe flight. Knowing the parts of a drone will give you extra confidence while flying and it will also help you for regular maintenance and inspection of your drone. If you have any flight problems knowing what each drone component does will assist you greatly in getting to the bottom of any flying issues. This is one of the best ways to become a skilled and successful drone pilot. This article will provide you with a basic overview of all major drone parts and components which you will find on a modern-day professional drone. Hopefully after this article you will have a better understanding how a drone actually works.



At present most popular form of drone is multirotor drone so let me explain you the major parts of this type of drone. Any multirotor drone consists of these following essential parts:

Frame, Motors, ESC (electronic speed controller), Propeller, Battery, Flight Controller, RC Receiver, Power Distribution Board, Sensors, GPS Module etc.

Brushless Motors: To neutralize the turning force produced by the rotating propellers drones (quadcopters) have two clockwise motors and two counter clockwise motors and this is simply because of Newton's Third Law which states that for every action there is an equal and opposite reaction. All the latest drones use a brushless electric motor which is more efficient, more reliable, and quieter than a brushed motor.

Propellers: Same like motors drones have two different kinds of propellers, one for each motor direction. Each propeller rotates pushing the air down on the airfoil surface resulting in a difference of pressure thus making the drone airborne.

FC (Flight Controller): The flight controller takes in inputs from the GPS module, available sensors and the remote controller then processes it into information that is given out to the ESCs to control the motors. This part of drone hence known as the brain of the drone.

ESC (Electronic Speed Controller): The ESCs are connected to the power distribution board (the battery) and the flight controller, as the ESCs receive signals from the flight controller it changes the amount of power given to each of the motors.

PDB (Power Distribution Board): This is like the motherboard of a computer, the place where all the drone's electrical components connect and draw power from the battery.

Camera: The camera captures video feed, allowing for real-time, FPV flight.

Gimbal: It's the mechanical piece that enables movement and stabilization of the camera.

LiPo Battery: LiPo stands for lithium-ion polymer battery which is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of the more common liquid electrolyte.

Frame and Boom: Frame is that plastic catching which holds everything together. In many drones, the boom is part of the main body. Other drone has a definite boom as a separate part.

GPS Module: The GPS module often combines GPS receiver and magnetometer to provide latitude, longitude, elevation, and compass heading from a single device. Without GPS, drones would have very limited uses.

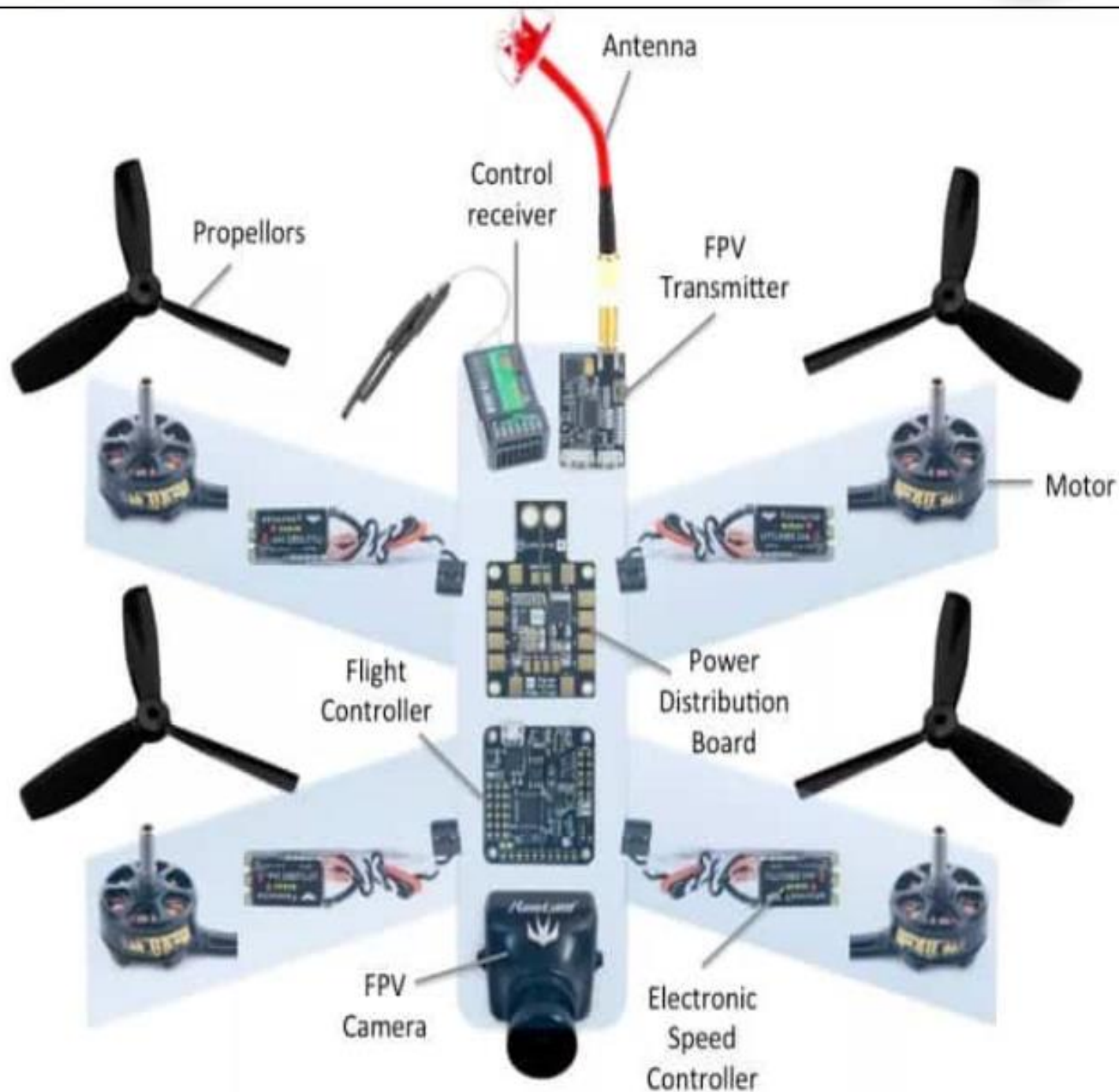
R/C receptor (RX): It's the sensor in charge of receiving the signals from the remote controller.

Remote controller (TX): Provides the link between the user and the drone. They usually look very similar to toy remote controllers, with the big difference that these ones have way more buttons and are significantly more sensible.

Video Transmitter (VTX): Video transmitter or VTX, connects to the FPV camera to transmit video to the FPV goggles or monitor. Most quadcopters these days use the 5.8GHz for video transmission.

FPV: Drone FPV (First Person View) Goggles or Screens are the devices used by pilots to observe the live video feeds being transmitted from their quadcopters.

Landing Gear: Most drones which carry payload comes with a fixed landing gear like helicopter mounted directly to the body. However, the best drones will have retractable landing gear thus allowing a full 360-degree view when in flight. Drones which have no hanging payload omits landing gear but if you fly in areas where there is long grass, rocks or dusts then either carry a big landing mat or you can buy leg height extenders.



How A Drone Actually Fly?

Lift

To get airborne, you must create lift. Lift is a force that pushes an object upward into the air and is created by varying the air pressure above and below an aircraft.

Directional Control

The most popular drones available today are multi-rotors. They maintain stability by varying the speeds of each propeller. Directional control in a drone is achieved by changing the angle of attack of the propellers, the same as a helicopter but this change in attack is accomplished by slowing some of the rotors.

Movements

For a multi-rotor drone, there are two crucial sensors that are required to be able to achieve smooth flight. Accelerometer detects linear movement which means movement in a straight line and Gyroscope detects rotational movement which means movement around a line.

Remote Control and Wi-Fi

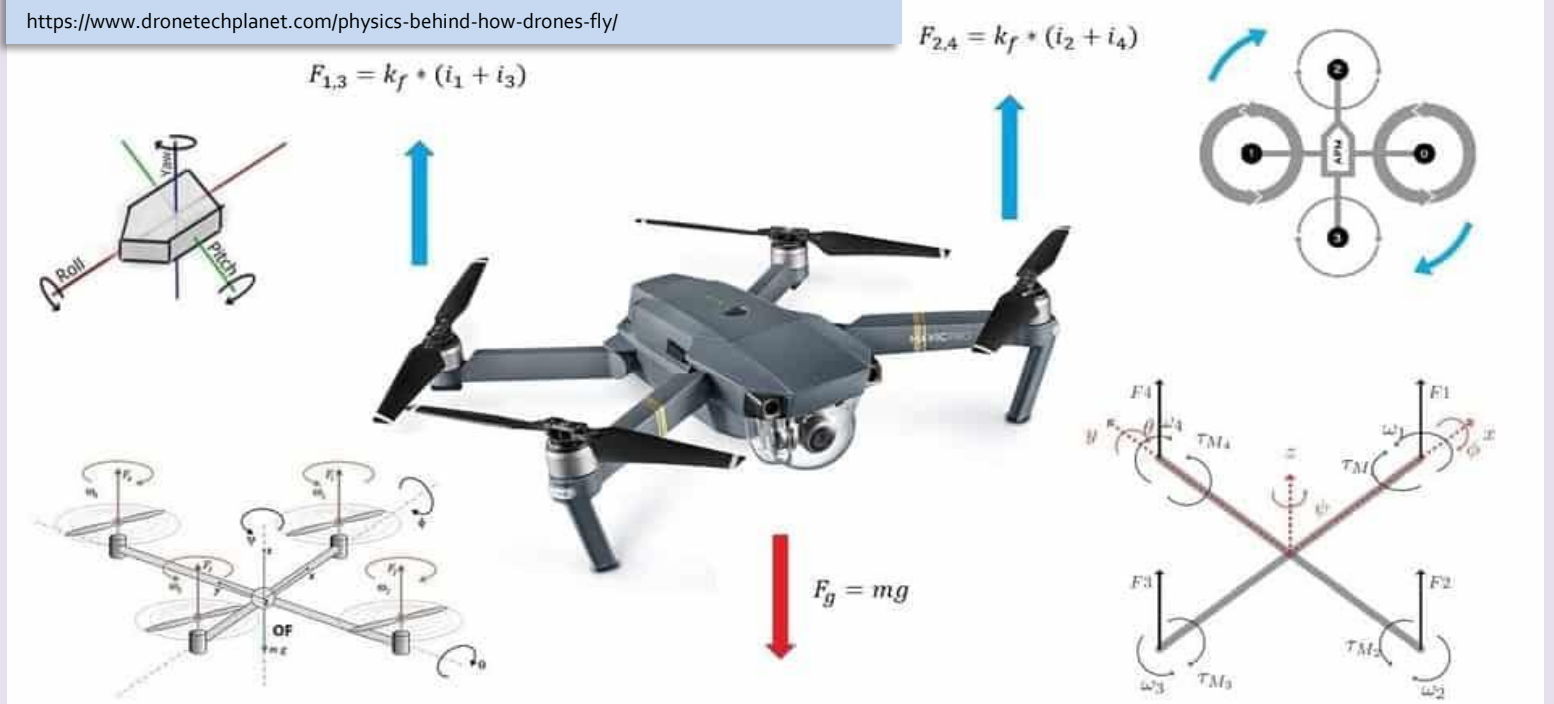
In order to control a drone remotely, you must be able to communicate with it wirelessly. Radio waves are an invisible wave form on the electromagnetic spectrum. For radio to work, you must have a transmitter to send the messages and a receiver to get the messages. More precisely, your transmitter and receiver need to be tuned to the same frequency. Most drones today are Wi-Fi enabled so that they can broadcast video to a computer, tablet, or smartphone. Some drones also use Wi-Fi for remote controlling through a tablet or mobile application.

GPS

GPS is primarily used to communicate location back to a mobile app. GPS is also used for pre-programming routes. Once programmed, the drone can be cut loose and it will fly in sequence to each of the GPS locations identified.

Physics Behind How Drones Fly

<https://www.dronetechplanet.com/physics-behind-how-drones-fly/>



Classification Of Drone

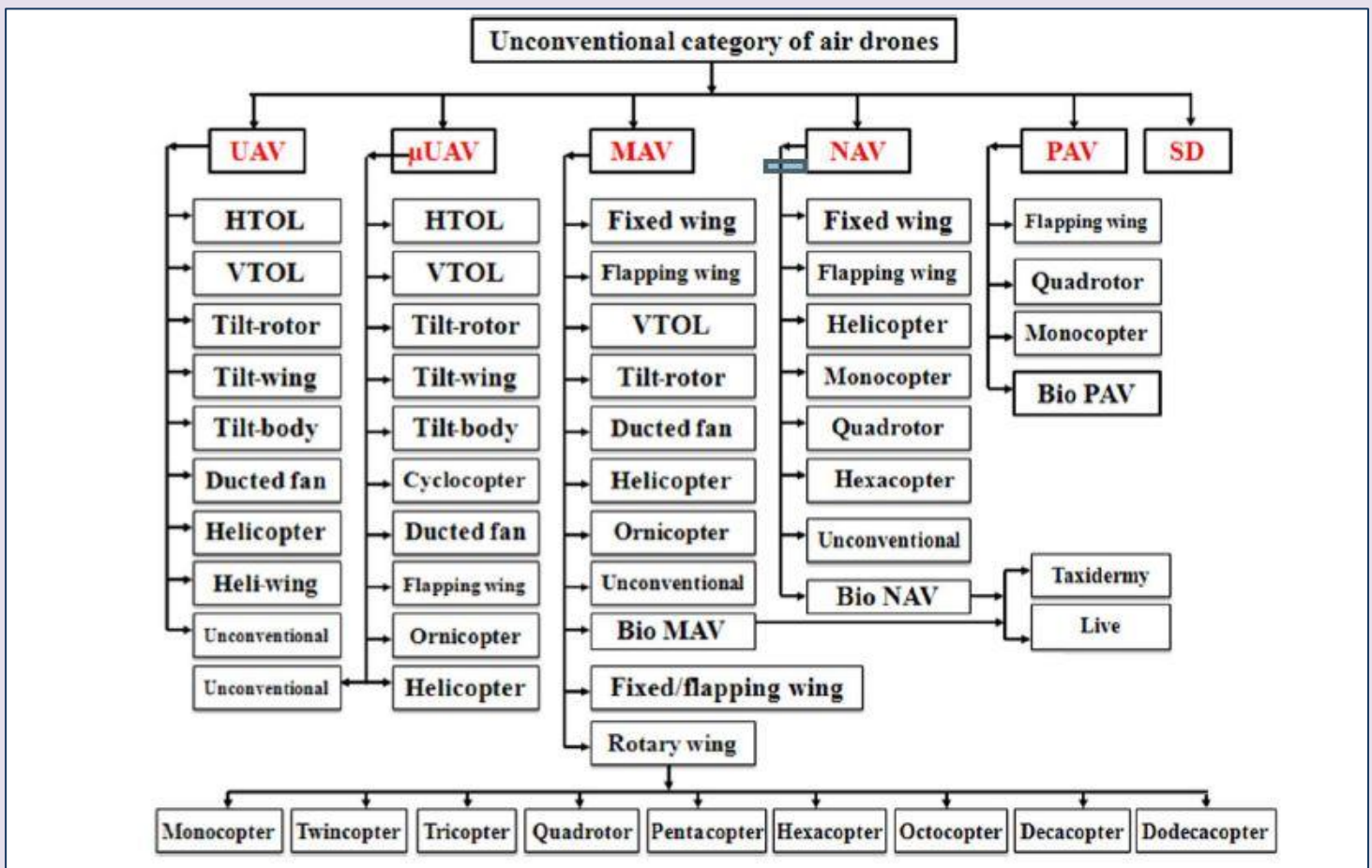
Classification of Drone:

Drones can be categorized by their size, weight, range, speed, endurance, production cost, propulsion etc. The conventional classification of drone doesn't show all those diversities available in UAV industry. Here drones can be of four types depending on their rotor or wing:

1. Multi-rotor drones
2. Fixed wing drones
3. Single wing Helicopters
4. Fixed wing Hybrid VTOL



Below this classification is from one recent research paper which categorized almost all drones available both in military and commercial market.



You will be amazed to see all these different varieties of drones available in today's market. Let's see some of them:

Micro Drone



Nano Drone



Pico Drone



MALE



HALE



LASE



LALE



HTOL



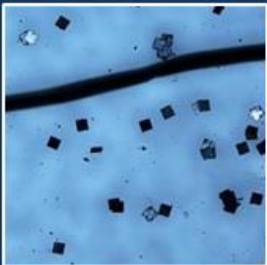
VTOL



TUAV



Smart Dust



Taxidermy Drone



Live Drone



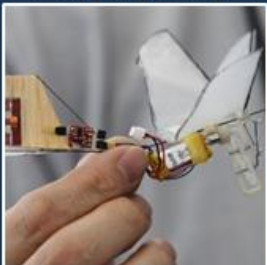
Fixed Wing



Rotary Wing



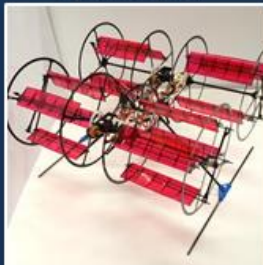
Flapping Wing



Helicopter



Cyclocopter



Coaxial Drone



Ornithopter



Quadcopter



Amphibious Drone



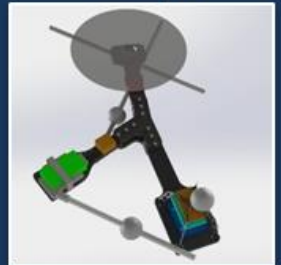
Blimp Drone



Marine Drone



Monocopter



Tilt Rotor



Tilt Wing



Tilt Body



Ducted Fan

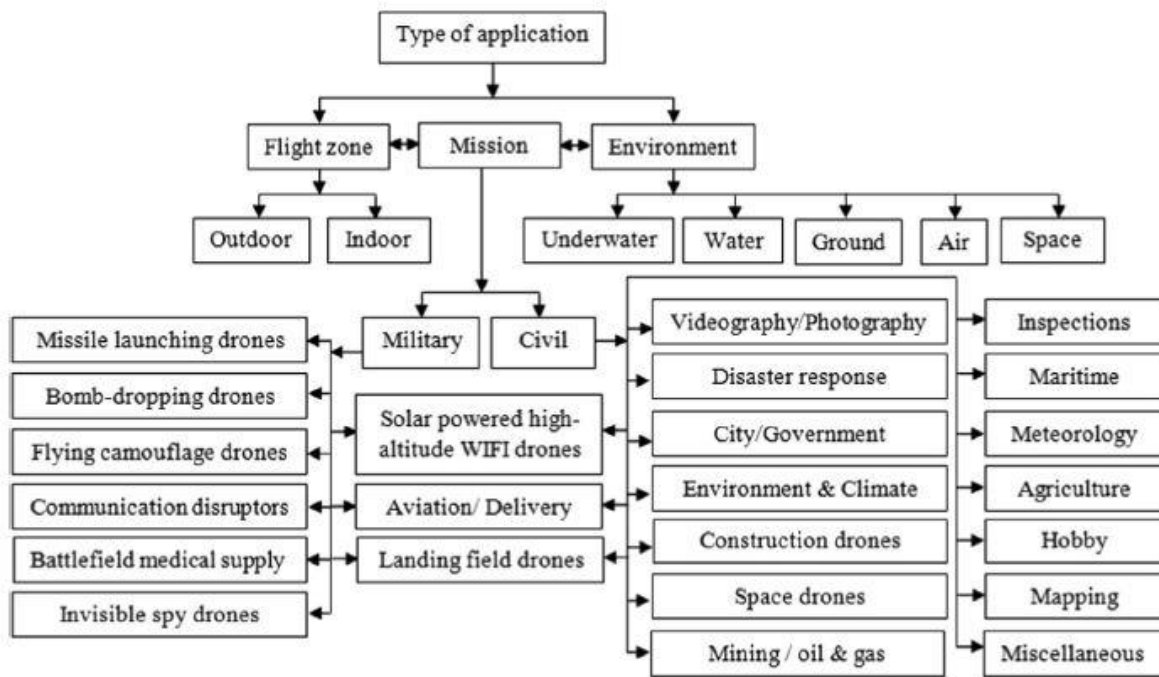


Heli Wing



Applications Of Drone

Ever imagined a military weapon will become a toy for kids, a tool for photographers or an extreme vehicle for racers? Initially known for their military use, drones are now being used by individuals to large companies to accomplish several tasks. Today, the application areas of drones are limitless. The technology that was once designed to destroy is now being used for the betterment of mankind. Drones have become an eye in the sky to give us the top down majority view. With drones being allowed for commercial use, an entire industry has emerged. That's why most developed and developing countries are working to integrate drones into their national airspace. In this section I will talk less rather I will show you around the immense uses of drones.



Military Applications of Drone

A military drone is not a multirotor type small UAV, it's an incredibly complex piece of engineering, and costs huge amounts of money to build and to fly. A consumer brand multirotor is cheap comparatively, at most the common store bought drone will cost you a few grand. The military drones are hundreds of thousands (possibly millions) of dollars. Drone Intelligence is now the most effective weapon & spy system in Military

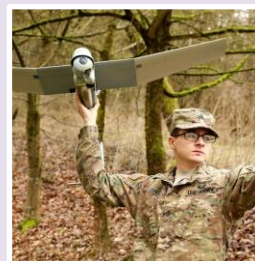
Stealthy Spy



Surveillance



Camouflage Drone



Missile Launching



Bomb Dropping



Network Disruptors



In addition to the massive size, military UAVs also have more secure communications, with the larger ones being satellite linked. Their sensors have greater fidelity, range, and versatility. Some of them can be shoulder-launched and turned into a weapon, exploding on contact. Others just plain carry bombs or missiles. The more advanced models can fly autonomously at times. So, you can imagine how different military and civil drones are both by physical aspects and applications.

Military Use



Entertainment



Agriculture



Journalism



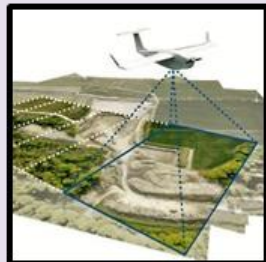
Disaster Response



Criminal Surveillance



Site Analysis



Cinematography



Cargo Delivery



Antidrone



Drone in Space



Marine Environment



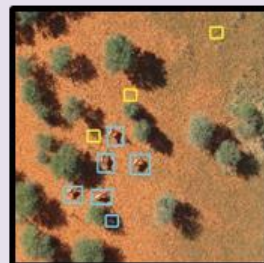
Spy Drone



First Aid



Wildlife Conservation



Fire Detection



Law Enforcement



Marketing



Exploration



Research



Police Response



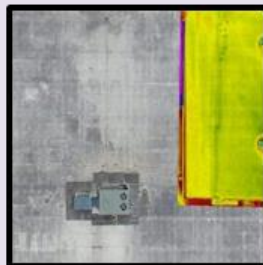
Aerial Photography



Monitoring



Leak Detection



Network Maintenance



Cleaning



Weather Forecast



Search & Rescue



Forestry



Transport



Things Every Drone Enthusiast Should know

For any photographers, hobbyists, and professionals as well drone is a must-have gadget nowadays. If you are a new drone pilot, I want you to take a quick look at these very necessary rules and tips. These will help you become a better drone pilot. I think it is important for every new drone pilot to know these flying rules and tricks to save their drone from crashing, to make them a conscious drone flyer who knows airspace requirements and UAV flying rules. By keeping these drone codes in mind, anyone will be a proficient operator within a short period of time. So, let's check them out:

The 10 Golden Rules

- I. No flight above 400ft(120m) from the surface.
- II. No flight within 150m of a congested area.
- III. No flight with 50m of people, property, vehicles or vessels not under their control.
- IV. No flight further than 500m from the operator.
- V. No person inside 30m on take-off and landing except the drone pilot or people under the pilot's control.
- VI. No flight inside 1km of the boundary of an aerodrome without permission.
- VII. No drone weighing 7kg (15lbs) or greater to fly in controlled airspace without permission.
- VIII. Never fly unless you are satisfied the flight is safe to be made and always check the weather frequently throughout the day.
- IX. Always check the controls for the drone are working perfectly before every flight even after a short break such as to change its battery.
- X. Only look at the screen on the controller to frame a shot or to check how much power the battery has remaining. Flying the drone by looking at the screen is bad practice. You should be looking at your drone and scanning for incursions by aircraft 99% of the time.

The Rule of Thumb

You may not remember all the regulations of flying responsibly but you shouldn't forget what **DRONE** stand for:

- **D**on't fly near airports or airfields.
- **R**emember to stay below 400ft (120m).
- **O**bserve your drone at all times – stay 150ft (50m) away from people and property.
- **N**ever fly near aircraft.
- **E**njoy responsibly.

Airspace Class G: The Only Flying Zone

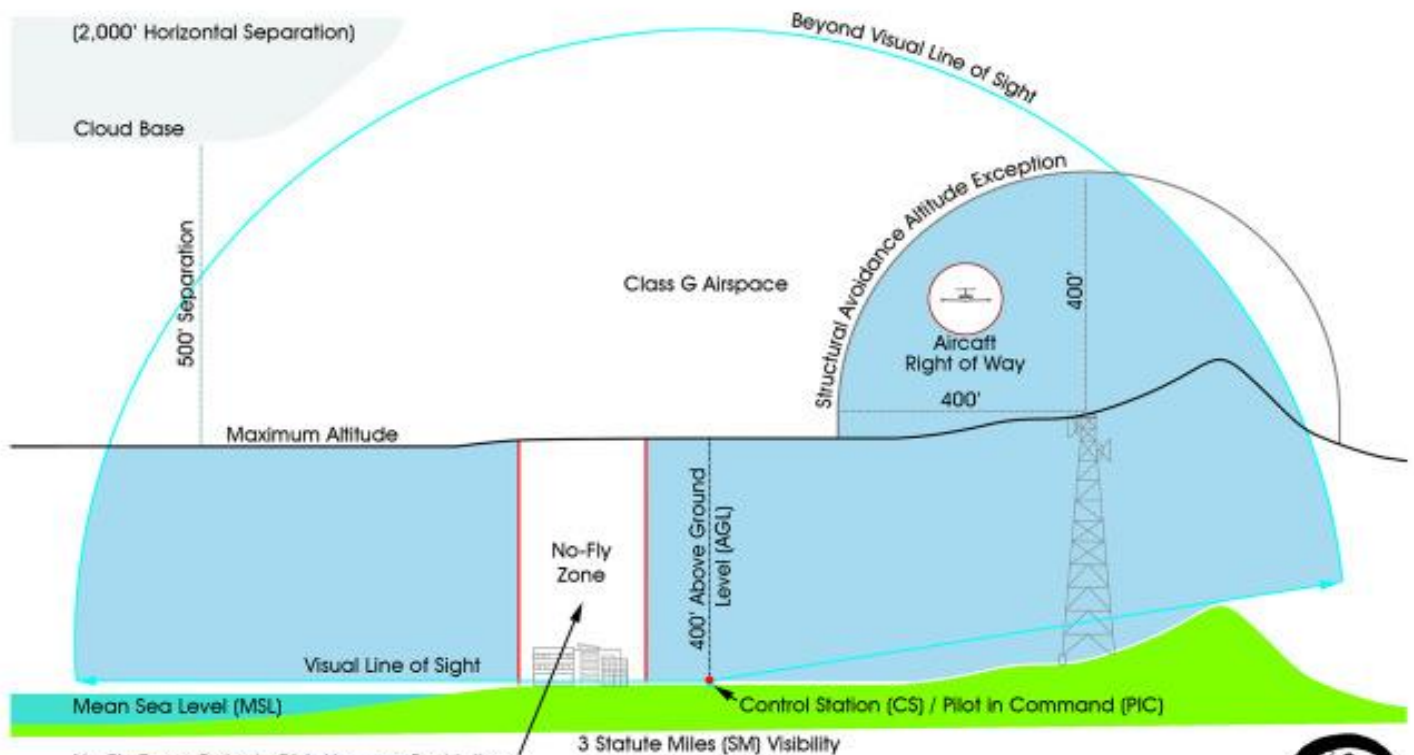
You have a drone you can fly it anywhere but there's some rules and regulations you must have to abide by before flying it. You should know that you are allowed to fly only in the uncontrolled section of airspace (Airspace Class G: airspace that doesn't fall under the authority of air traffic control). You are not allowed to fly over crowds or in the vicinity of airports. You need a permit to fly over protected nature areas also. If you want to fly over airspace G you have to follow this process:



Airspace is the portion of the atmosphere controlled by a country above its territory, including its territorial waters or, more generally, any specific three-dimensional portion of the atmosphere. Class G airspace is typically the airspace very near the ground (1,200 feet or less). The rules for flying your drone inside Airspace G are as follows:

- You are prohibited to fly your drone higher than 120-metres above the ground or water
- You must give way to other aircraft
- You must fly at a safe distance from people and buildings.
- You should also ensure that you can always see your drone. It's forbidden to fly in the dark.

Drone Airspace



No-Fly Zone: Refer to FAA Airspace Restrictions
Waivers/Authorizations: Airspace restrictions may be exceeded with approved operational or controlled airspace requests
Visual Line of Sight (VLOS): ~1,000' [2' diameter object & 20/20 vision]



How to Get a Drone License?

You need a drone license when you use your drone for work or business, i.e. commercial use.

You do not need a drone license when you fly your drone strictly for fun as a hobby, i.e. recreational use.

Please read this article to know more about it: <https://www.dronepilotgroundschool.com/drone-license/>

Learn to Fly A Drone

If you are your own guide to learn drone piloting things can be a bit tricky so in this article, I will walk you through the effective way of flying a beginner's multirotor drone. I am not a licensed drone pilot yet. I followed these following guides before my first flight. These guides are more than enough for a novice to start with. After some days of continuous learning and concentrated practice with patience you will get your rewarded place as a perfect drone pilot. Fixed wing drones are not for beginners and not for recreational use even. Multirotor drones are perfect trainer craft to fly as novice. So, follow these steps to start your UAV flying experience with a Quadcopter:

Step 1: First thing first, read these five guides very well. In these following guides, you'll learn how to fly a quadcopter or any other multirotor drone:

1. <https://uavcoach.com/how-to-fly-a-quadcopter-guide/>
2. <https://dronenodes.com/how-to-fly-a-quadcopter-beginner-guide/>
3. <https://www.droneriot.com/how-to-fly-a-drone-for-beginners/>
4. <http://fromwhereidrone.com/how-to-fly-a-drone-the-ultimate-guide/>
5. <https://fpvdrone reviews.com/fpvdrone reviews-com/how-to-fly-a-drone-2/>

Step 2: After finishing all these guides even if you just finish first one, I am expecting you to have all the basic theoretical knowledge this is necessary throughout your whole drone piloting career. Instead, I want to emphasize on learning at least these topics:

- Understand the drone controls (Right stick, Left stick and trim buttons)
- Familiarize yourself with drone parts and how they work (ESC, FCB, Transmitter, Motors)
- Learn about different flight modes (Manual, ATTI Mode, GPS, Headless Mode)
- Learn how to calibrate your drone before takeoff.
- Learn the basics of drone maintenance (Visual Damage, Battery, Propellers)

Step 3: Now I want you to take the manual book of your new drone and read it very carefully cause without knowing your vehicle you can't pilot it smoothly.

Step 4: Here comes the fourth step, I want you to step outside now in an open space by keeping local flying rules and regulations in mind. Check the physical condition of your drone and surrounding environment according as preflight checklist and make it as habit before your every flight. Now take-off and continue flying like these exercises for one week. Please without finishing first two steps don't let your excitement bring you outside for flying.

- ✓ Fly side to side, Forward & Back
- ✓ Fly in square
- ✓ Fly in circle/orbit
- ✓ Fly like figure 'eight' 8
- ✓ Master the art of rotation, hover and continuous fluid flight

Step 5: Finally, I am assuming now that, you are a startup drone pilot. From now on you will guide yourself with the love and patience for drone. If you feel less confident there's no better option than practice flying in a drone simulator software. Also don't forget to check out all those free tutorials in YouTube; trust me with these much resources available for free learn to fly a drone is no more a hard job rather fun.



7 Very Necessary Flying Tips:

1. Try an R/C Flight Simulator (like: Heli-X UAV Flight Simulator, FPV Freerider).
2. If you're about to crash into something, turn the throttle down to zero instantly.
3. Join in a drone club or fly with your peer group to learn enthusiastically.
4. Know thyself (licensed or not). Be responsive, safe and aware. Read your drone manual carefully.
5. Practice these patterned flying maneuvers: \square \odot ∞ (square, circle, figure-8).
6. Plan ahead & check your drone before you fly. Go through a pre-flight checklist, just like a real pilot.
7. Learn to Fly Toward Yourself. One of the most common reasons new and experienced pilots even crash is because drone become disoriented. When the drone is pointed at you everything is backwards so Keep your drone in sight but practice flying like this to make you expert flyer.



Commercial Airplane Pilot inside Cockpit



FPV Drone Pilot



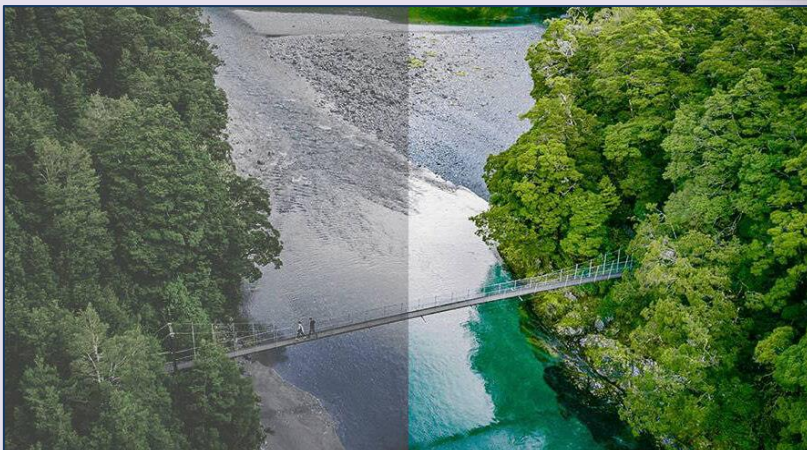
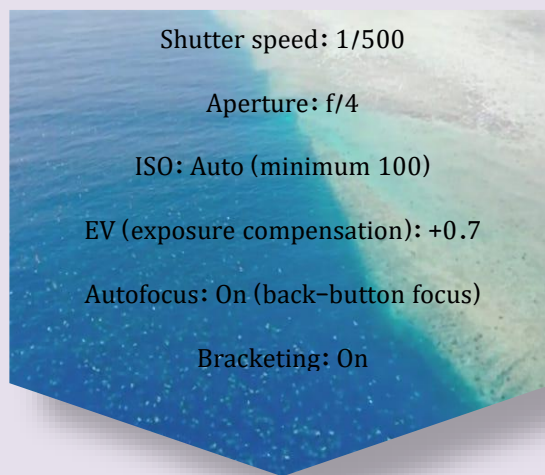
Military UAV Pilot flying from Ground Station

Tips for Aerial Photography

What do most people do with their drones?

Well, instantly after learning to fly and maneuver they dive into the world of photo and videography and you will get to know why it's so popular when you will see your first shot from Birds Eye view. So, get ready to be an aerial photographer. According to Wikipedia, Aerial photography (or airborne imagery) is the taking of photographs from an aircraft or other flying object like Drones or UAV.

- Learn to fly before you learn to shot. Don't jump into AP (Aerial Photography) until you can confidently fly BVLOS (Beyond visible line of sight) and make sure you are not afraid of flying too far or too high.
- Great AP requires you to learn some specific drone maneuvers. Some of the most popular methods are namely: **Tracking, Look Up, Pull Back, Fly Through, Birds Eye, Slide Shot, Tripod Shot** etc.
- Beware of the weather! Try and shoot in warmer, drier, less windy conditions. Also be mindful of Sun, lighting matters a lot when it comes to photography.
- Always analyze your photography site before lifting off from the ground and that's actually how all those marvelous shots come from the best photographers around the globe. They plan a lot and then fly the site as they want.
- **The 5 R** - Select "Right Drone" for your photography with at least a minimum good quality camera and then of course select the "Right Location" with beautiful view. Trust me you should consider lighting and timing a lot so select the "Right Time" and do a "Right Plan". Finally, you need to learn some camera setting of course to reach a professional level but for beginning please familiarize yourself with "Right Shutter Speed" setting.
- The optimal setting for Aerial Photography: With aerial photography, your number one priority in the exposure triangle (shutter speed, aperture, ISO) is going to be shutter speed.



My First Drone Flying Experience

I got my first drone at **50\$** price. It was a Chinese brand drone named **RxRc HLEkuku-s19**. I had no idea about drone so before buying I spent two weeks for gaining essential theoretical knowledge and watched couple of flying tutorials. This really helped me to get enough confidence for my first solo flight. By the way in this section I won't share my memories rather I will tell you to avoid these mistakes below I committed which caused my drone grounded after two weeks of flying.

- 1) Don't buy expensive drone equipped with camera if you are novice. Your first drone should be a small and cheap quadcopter drone for training purpose. Trust me for most people their first drone lasts less than a month.
- 2) Learn to fly in patterns although it's boring and you will be impatient to repeat these patterns (**square, circle, figure 8**) but these are the most important training exercises for becoming an expert drone pilot.
- 3) You should have an overall idea of the mechanism of drone and how it's flying. What I mean is gain some technical knowledge so that you can find out and give initial response to any issues occurring in your drone while flying.
- 4) Learn the Trim buttons very well. Get yourself confident with the remote control and flight software interface.
- 5) Get yourself comfortable with flying the drone while it faces different direction so that you can fly high and far beyond visible line of sight.
- 6) Don't fly indoor when you are in training session. I crashed my drone with wall first day after unboxing. Always practice flying in an open ground at early morning.
- 7) Always carry the **Flight checklist** and check accordingly before takeoff and after landing.

LET US DRONE

FLIGHT CHECKLIST

WHILE AT HOME	
<input type="checkbox"/> Check Weather	<input type="checkbox"/> SD Card Formatted
<input type="checkbox"/> Drone Batt. Charged	<input type="checkbox"/> All Gear Ready
<input type="checkbox"/> Controller Charged	<input type="checkbox"/> Check NOTAMS
<input type="checkbox"/> App Updated	<input type="checkbox"/> Research Flight Area
<input type="checkbox"/> Firmware Updated	<input type="checkbox"/> Get Permissions
BEFORE TAKEOFF	
<input type="checkbox"/> Notify Spectators	<input type="checkbox"/> Calibrate Compass
<input type="checkbox"/> Unpack Equipment	<input type="checkbox"/> Check Satellite Strength
<input type="checkbox"/> Insert SD Card	<input type="checkbox"/> Check Signal Strength
<input type="checkbox"/> Remove Gimbal Lock	<input type="checkbox"/> Ensure RTH is set
<input type="checkbox"/> Inspect Drone <small>(batt fitted, props secure, no cracks)</small>	<input type="checkbox"/> Specify Lost sig. Action
AFTER TAKEOFF	
<input type="checkbox"/> Hover Nearby for 20 seconds.	
<input type="checkbox"/> Listen & Watch for any Abnormalities	
<input type="checkbox"/> Test Controls	
<input type="checkbox"/> Continuously Monitor Signal Strength	
<input type="checkbox"/> Keep Drone Within Visual Line of Sight	
ONCE LANDED	
<input type="checkbox"/> Turn off the Drone, Then the Controller	
<input type="checkbox"/> Ensure Desired Footage was Captured	
<input type="checkbox"/> Inspect Drone for any Damage	
<input type="checkbox"/> Fasten Gimbal Lock	
<input type="checkbox"/> Pack Equipment & Log Flight	













World's Most Famous Drones & Their Specs

If you are thinking why you need to know the most famous and best drones of aviation market the answer is Just to keep yourself updated with the new emerging techs from Unmanned Aviation and by reverse engineering who knows maybe you can implant a revolutionary model.

Being a prominent drone is not that easy, it needs high performing features to win over other drones all around the world. As I told earlier "DJI" a Chinese company alone captured more than 70% of civilian drone market and for Military UAV "General Atomics" & "Northrop Grumman" are two prominent US company to manufacture some leading military drones of all time.

Below are two tables showing the top 5 famous drones (both Military and Civil) till now and their crucial specs:

Name of Drone	MQ-9 Reaper (Predator)	RQ-4A Global Hawk	MQ-1C Grey Eagle	TAI Anka	CH-5
Country of Origin	USA	USA	USA	Turkey	China
Manufacturer	General Atomics Aeronautical Systems, Inc.	Northrop Grumman	General Atomics Aeronautical Systems, Inc.	Turkish Aerospace Industries (TAI)	China Aerospace Science and Technology Corporation (CASC)
Payload Capacity	Up to 3,800 lb (1,700 kg)	up to 3,000 lb (1,360 kg)	1,075 lb (488 kg)	200kg	1000kg-can carry 16 missiles at a single time
Service Ceiling	50000 ft	60000ft	29000 ft	30,000 ft	9km
Engine	Honeywell TPE331-10GD turboprop	Rolls Royce-North American F137-RR-100 turbofan	Thielert's heavy-fuel engine	1 × Thielert Centurion 2.0 turbocharged four-cylinder engine	unidentified turbo-charged piston engine
Type	Strike, coordination and reconnaissance	intelligence, surveillance and reconnaissance, or ISR	Reconnaissance, Surveillance, and Target Acquisition (RSTA) and attack operations	Tactical surveillance and reconnaissance missions	Combat and reconnaissance drone
Range	1150 miles	8700 nm	2500nm	3024 mi (4896 km)	10000km
Picture					

Name of Drone	DJI Inspire 2	DJI Mavic 2 Pro	DJI Mavic Mini	DJI Phantom 4 Pro	Parrot Anafi
Manufacturer	Dà-Jiāng Innovations (DJI)	Dà-Jiāng Innovations (DJI)	Dà-Jiāng Innovations (DJI)	Dà-Jiāng Innovations (DJI)	Parrot
Flying Range	4.3 miles (7 km)	18km	4.2 miles (6.76 km)	4.3mi (7km)	2.5 miles
Flight Time	Up to 27 minutes flight time	31 minutes	30 minutes	30 minutes	25 min
Operational Height	5000 m	6000 m	1.86 mile (3 km)	6000 m	4500m ASL
Speed	Maximum flight speed of 94 km/h	72 km/h (S mode)	46.8 km/h	72 km/h (S mode)	55km/h
Price	\$3299	\$1499	\$399	\$1499	\$699.99
Picture					

Drone Industry

Undoubtedly drone industry is one of the biggest industries in today's economy which is constantly increasing its expanse both by consumer and application aspects. Drone market consists of these three major user fields:

- Military 70%
- Consumer 17%
- Commercial 13%

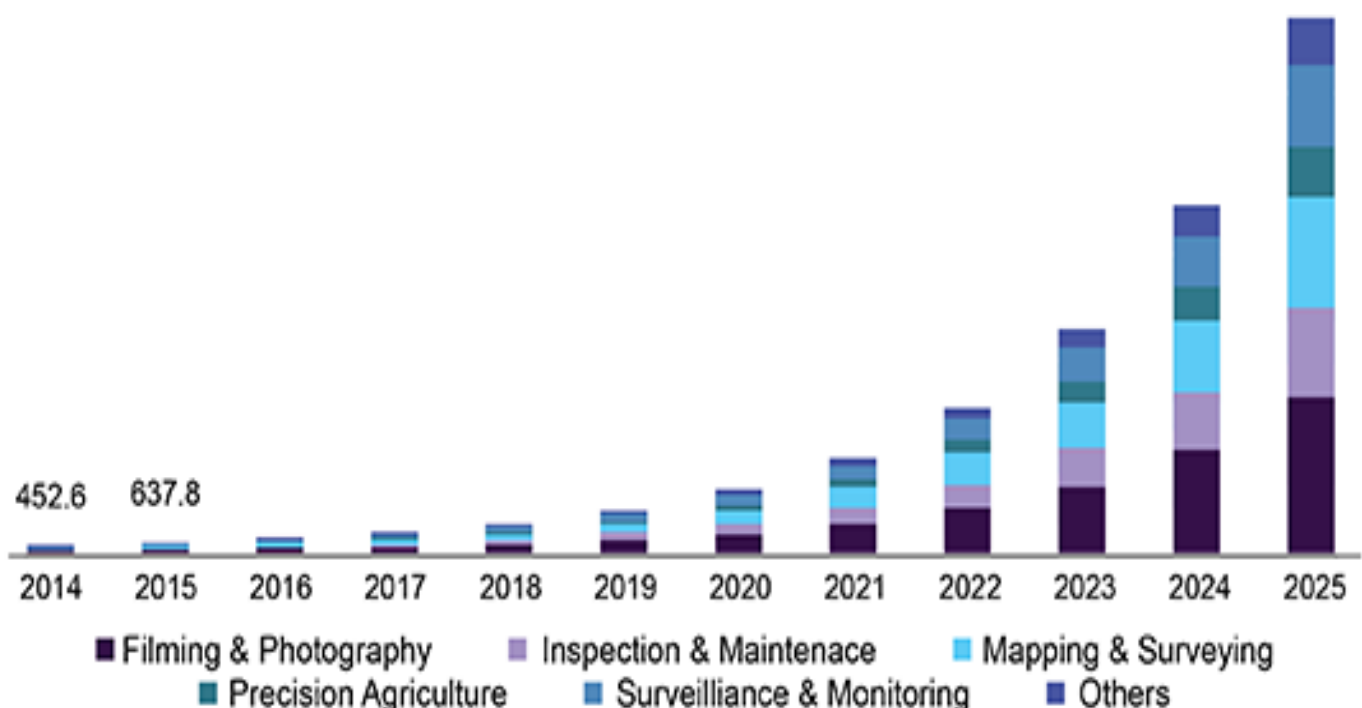
Prominent market research company “Envision Intelligence” narrated why military field covered whole 70% of the total share. It's just because of the increasing needs for the surveillance, target acquisition, reconnaissance and information gathering etc. Rising usages of drone in agriculture and top view demands will move forward the rest two sectors. The main consumer group of commercial drone markets are people related to film and TV industry, photographers and movie workers.

Due to the emergence of technologically advanced products, promising growth rate of the drone market and an emerging market for location-based drop shipping the drone market size has increased.

According to reports, sales volume of commercial drones rose by about 60% in 2017. By 2020, the U.S. is expected to have nearly seven million drones. Sales of the drone have shown no sign of slowing recently, and are still on an upward trend, with the drone industry expected to be worth \$127 billion. So, for sellers who are doing drone drop shipping, there is a huge market demand.

Below this graph is showing the constantly increasing trend of drone market in USA. As you can notice this forecast confidently showed the rise till 2025 and no doubt this trend will further increase in future decades.

U.S. commercial drone market size, by application, 2014 - 2025 (USD Million)



Top 5 Commercial Drone Manufacturers

1. **DJI** is a world-leading manufacturer of commercial unmanned aerial vehicles for aerial photography and videography. This Chinese company is the dominant market leader in the civilian drone industry, accounting for over 70% of the world's drone market.
2. **Parrot**, a company mostly known for toy drones and beginner's drone. Parrot SA is a French wireless products manufacturer company based in Paris, France.
3. **3DR** is an American company headquartered in Berkeley, California which makes enterprise drone software for construction, engineering and mining firms, along with government agencies.
4. **Yuneec** International is a Chinese aircraft manufacturer based in Jinxi, Kunshan, China. Yuneec was originally a manufacturer of radio-controlled model aircraft. In 2014 the company became a founding member of Drone code
5. **Aeryon** Labs is a Canadian developer and manufacturer of Unmanned Aerial Vehicles.

Top 5 Military UAV Manufacturers

1. **General Atomics Aeronautical Systems, Inc.** provides unmanned aerial vehicles and radar solutions for the U.S. military and commercial applications worldwide.
2. **Northrop Grumman** Corporation is an American global aerospace and defense technology company. It is one of the world's largest weapons manufacturers and military technology providers.
3. **Israel Aerospace Industries Ltd** manufactures civilian and military aerospace and defense products. The Company provides business jets, unmanned aircraft, and a range of systems including defense electronics, theater defense, defensive and offensive naval weapons, and airborne radars.
4. **The BAE Systems HERTI** is an unmanned aerial vehicle (UAV) developed by the British company BAE Systems.
5. **The Boeing Company** – the world's largest aerospace company and America's largest exporter; assembles commercial airplanes and defense products and also builds aerospace components in the United States.



The first drones to fly under radio control that were capable of returning were the 'Queen Bees' that were in service with the British forces in the 1930s. The term Drone almost certainly derived from these de Havilland Queen Bee DH82B aircraft. She is indeed the Mother of all Drones.

Drone Manufacturing Process

In this section you will get a good basic idea of RTF (Ready to Fly) type drone manufacturing process. Just to let you know there are three types of drone in terms of production process.

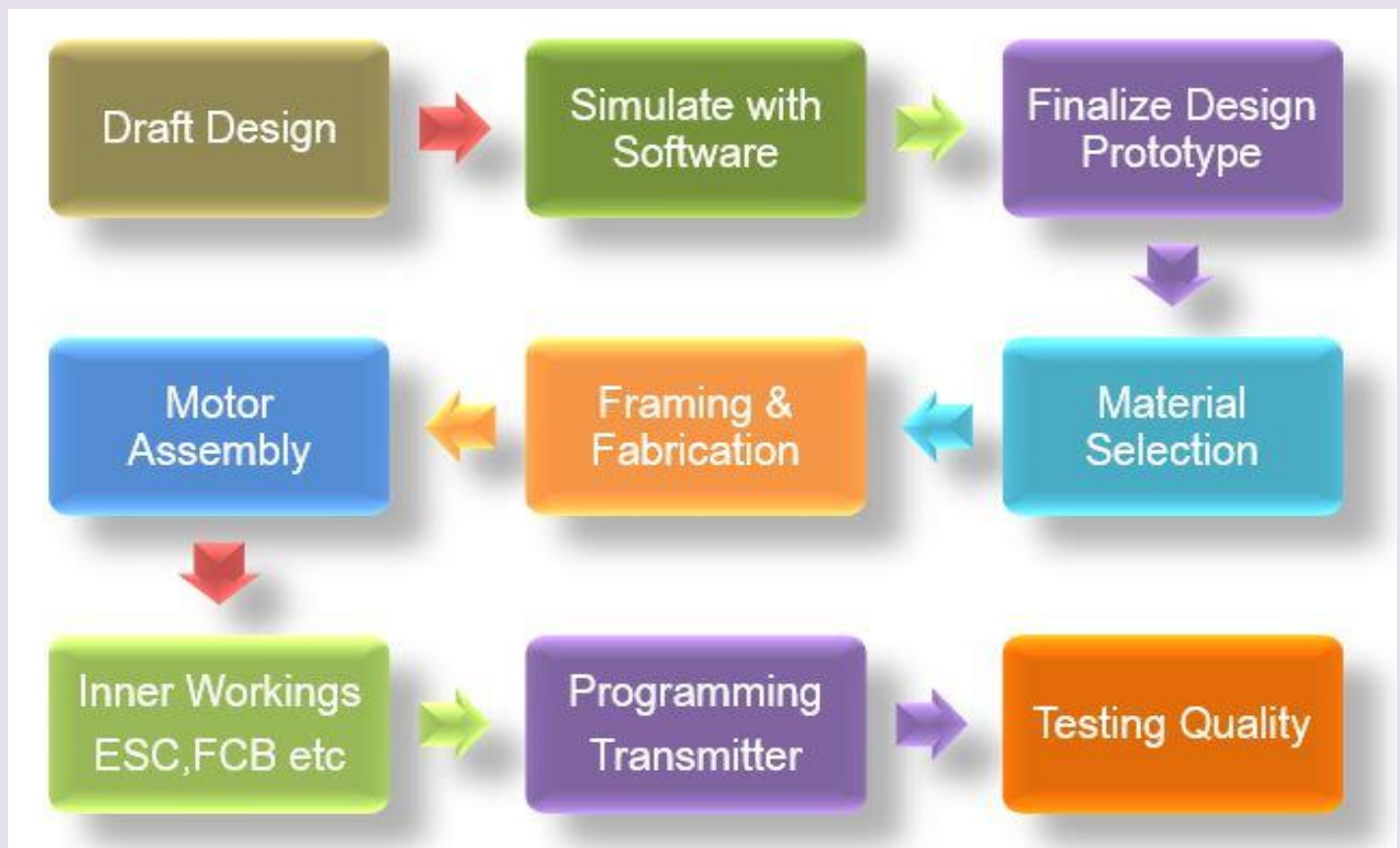
1. RTF-Ready to Fly
2. BNF-Bind and Fly
3. DIY-Do It Yourself

Drone is really a complex machine. Manufacturing a drone needs some extremely concentrated workers with proper skills for assembling every parts. Let's see how RTF drones are made in factory.

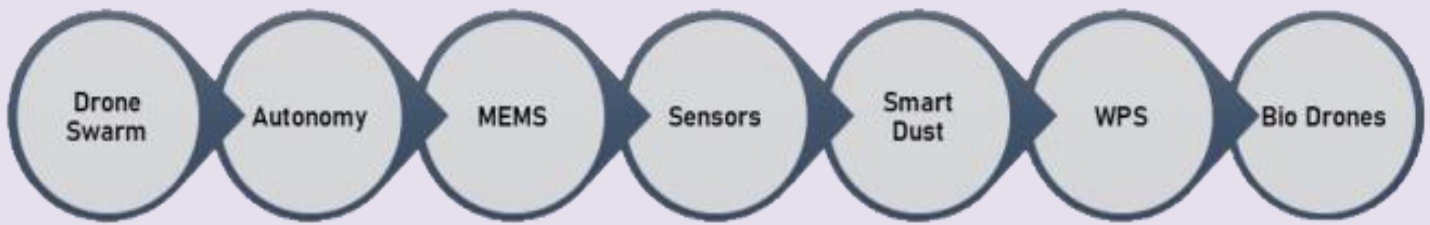
No wonder any manufacturing begins with a blueprint, planning or prototyping ideas. Design planning is the most crucial of all manufacturing process. A drone prototype starts with a proposed design and analyzing all its specific purpose and basic functions. After this comes the Framing process. For drones which mainly starts after selecting a specific material (Carbon Fiber, PVC, hollow metals or any lightweight materials). Depending upon the factory for making the drone frame or other parts these three methods are widely used

- CNC cutting
- 3D printer
- Molding

Motor Assembly, Connecting Propellers and other inner workings (attaching ESC, FCB, RC receiver, Circuitry to run motors etc.) done by specialized and skilled engineers to ensure the desired quality of every drone. Then comes the programming part; another sophisticated work which needs to be finish with no error. This part of manufacturing assures the communication between transmitter and drone. Finally like all other manufacturing process drone needs to be check, recheck and more rigorous flight-testing process for quality assurance.



High-tech in Drone



Drone Swarm:

Swarming Technology Lets Drones Work as a Team. A swarm flight of UAV is a set of aerial drones that work together to achieve a specific goal. The flight of the drones is controlled either manually by remote control operations or autonomously by using processors deployed on the drones. In swarm flight all the drones fly together like a flock of birds, tracking their positions and maintaining their relative positions in the air. Human operators are not needed for every flying drone; instead, they direct the flock as one. The control algorithms continuously take feedback and adjust the throttle of the motors, thereby controlling roll, pitch, yaw, and thrust of the drone.



Autonomy:

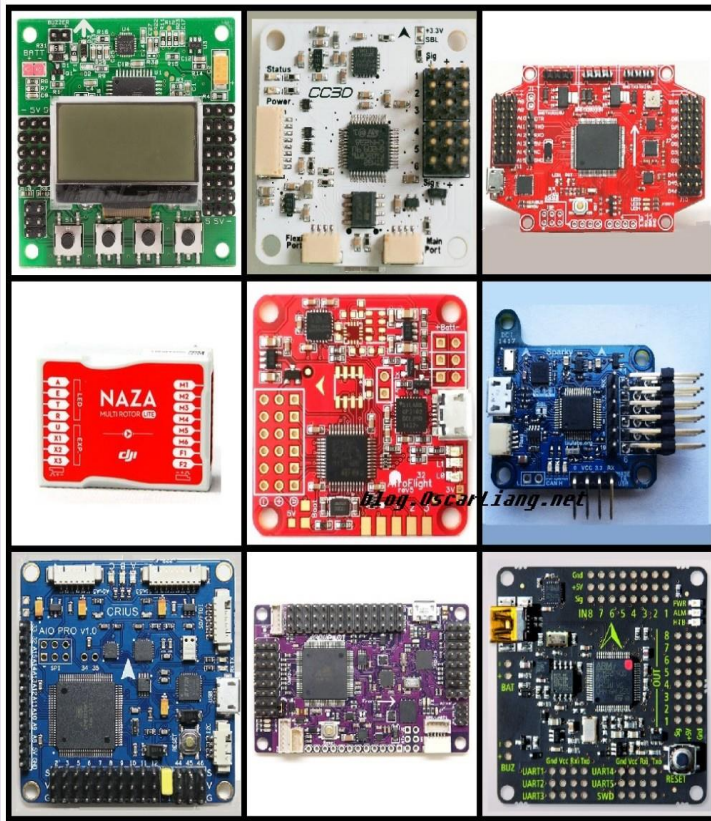
The ability of a UAV to take off, execute a mission, and return to its base without significant human intervention is basically Autonomy. Future UAVs will operate with varying levels of human interaction and will require the ability to process sensor data onboard and to operate using high-level, autonomous behaviors. Basic autonomy comes from proprioceptive sensors. Advanced autonomy calls for situational awareness, knowledge about the environment surrounding the aircraft from exteroceptive sensors.

These are the common autonomous operations in today's drones:

Altitude hold, Hover/position hold, Headless mode, Auto Take-off and landing, Failsafe, Return-to-home, Follow-me, GPS waypoint navigation, Orbit around an object.



Micro Electro-Mechanical System (MEMS):



Micro-electromechanical systems (MEMS) is a process technology used to create tiny integrated devices or systems that combine mechanical and electrical components. They are fabricated using integrated circuit (IC) batch processing techniques and can range in size from a few micrometers to millimeters. MEMS and the related micro mechatronics and microsystems constitute the technology of microscopic devices, particularly those with moving parts. They merge at the nanoscale into nanoelectromechanical systems (NEMS) and nanotechnology.

Nowadays drone manufacturing especially nano, micro, Pico scale UAV and for smart dust; engineers are using MEMS, NEMS. Without these microchips we simply can't imagine SBC (Single board computer), SOC (System on a chip), Microprocessors, sensors. This miniaturization is very effective technology in drone revolution.

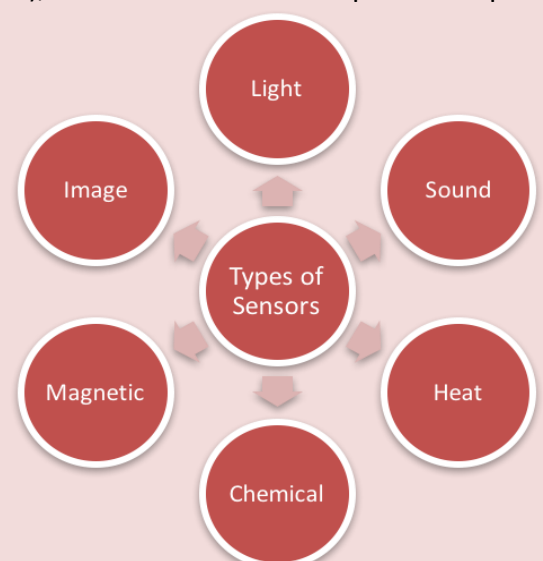
Sensors:

We live in a World of Sensors. A sensor is a device, module, machine, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor. In UAV Position and movement sensors give information about its state. Exteroceptive sensors deal with external information like distance measurements, while exproprioceptive ones correlate internal and external states. Non-cooperative sensors are able to detect targets autonomously so they are used for separation assurance and collision avoidance.

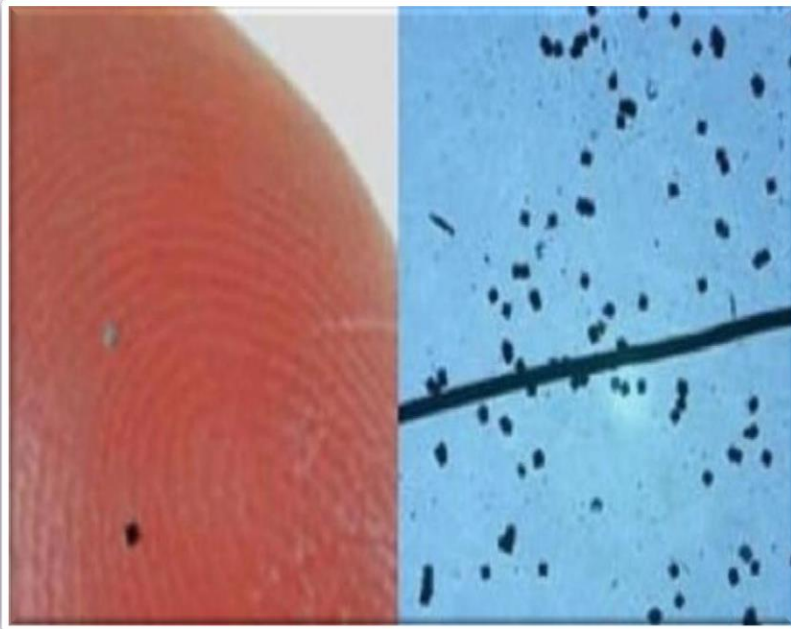
Degrees of freedom (DOF) refers to both the amount and quality of sensors on board: 6 DOF implies 3-axis gyroscopes and accelerometers (a typical inertial measurement unit – IMU), 9 DOF refers to an IMU plus a compass, 10 DOF adds a barometer and 11 DOF usually adds a GPS receiver.

These are the common sensors you will find in most drones:

1. Gyroscope
2. Barometers
3. Accelerometer
4. GPS
5. Magnetometer
6. Rangefinder
7. Inertial Measurement Unit (IMU)
8. Obstacle avoidance
9. Current Sensors



Smart Dust:



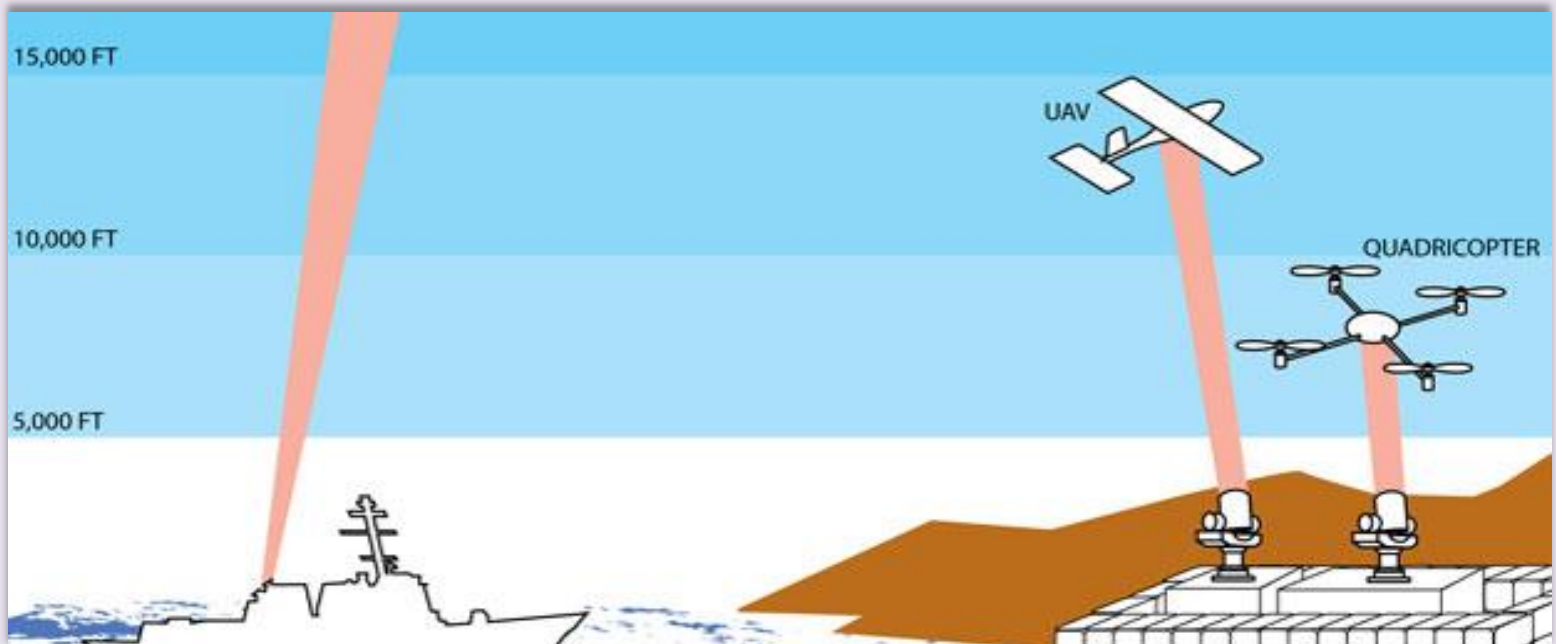
Basically, this is a swarm of airborne micro-drones. Our journey toward smart dust was possible just because of drone miniaturization. Some of these dusts are self-propelled. In this case, the user has control over where the individual particles/motes go, making them easier to recover for clean up or reuse.

Smart Dust is made of “motes” which are tiny sensors that can perform a variety of functions. They are made of microelectromechanical systems known as MEMS. It is a system of many tiny microelectromechanical systems such as sensors, robots, or other devices, that can detect light, temperature, vibration, magnetism, chemicals and other stimuli.

Wireless Power Supply:

Wireless Power Transmission for UAV Charging is a great innovation which is still in progress. The main limitation of electric-powered UAVs is their range and endurance, due the limited battery capacity. Increasing battery system size is not a viable solution as its weight becomes a limiting factor. Supercapacitors are not an option, because of their low energy density. An alternative is to recharge UAV on the job, using wireless energy transfer (WET). WET was originally investigated by Nikola Tesla in the beginning of the 20th century.

Notice the picture how actually this power supply working. The closer the drone is to the charging pad, the greater the voltage and charge that can be generated. The closer the drone is to the charging pad, the greater the voltage and charge that can be generated. This wireless power transfer station could be positioned at multiple locations, bypassing the need for a UAV to visit a particular location to charge, and increasing the radius of operation.



Bio Drones:

You won't believe this ridiculous but true fact that we have Catcopter, Ratcopter, Ostrichcopter, Orvillecopter and much more where researcher use taxidermy animals to make a drone platform as natural as possible for getting the best performance. For all taxidermy drone scientist use dead animal's body but here we have another kind of Bio drone that is "Live Drone" which is my personal favorite.



Imagine you are controlling a pigeon or any birds with a microchip & sensors. You can literally control them remotely and get them done what you wish for. A big clap for our drone scientists and neurologists for this awesome artificial and natural integration.

Technical Jargon-30 must know Drone Terminology

Aviation has its own language. Abbreviation is most often prior to elaboration here just to avoid complexity but sad is that we average guys fall in confusion of these words. The drone has a language of its own (Unmanned Aviation). So, in this section you will learn almost all necessary vocabs to make you fit as perfect hobbyist drone enthusiast. Below is a list of the most used drone lingo and abbreviations that you should must know. These definitions are often used by worldwide drone manufacturers, hobbyists, military, aviation authorities and airlines so to integrate yourself fully in drone world you must learn how to talk like professionals.

S, P, A, C Modes

- **S mode:** Sport Mode increases the available speed of your aircraft by only using GPS signal. Vision and infrared systems will not be available.
- **P mode:** Positioning Mode is the standard flight mode for the majority of pilots. In this mode, all the sensors on your aircraft are active, GPS and any available vision or infrared sensors. This results in precise hovering of your aircraft, even if you stop controlling it with the remote controller.
- **A mode:** ATTI Mode will only maintain the altitude of the aircraft and does not use any GPS or vision systems. The aircraft will therefore drift and move in any wind and needs to be manually controlled.
- **C Mode:** Cinesmooth. Use this mode for exceptional smooth flying which is great when

ESC

Electronic speed control. Controls the drones motor. It connects the RC receiver and main battery.

FC

A flight controller (FC) is a small circuit board of varying complexity. Its function is to direct the RPM of each motor in response to input.

Gimbal

A gimbal is the mount upon which a drone's camera sits, usually allowing the camera to move along multiple axes by remote control. This allows the UAV photographer a diversity of shooting angles.

Gyroscope

A gyroscope measures the rate of rotation of the UAV and helps to keep balanced correctly with respect to yaw, pitch and roll.

Servo

A shorter name for servomotor or servomechanism.

Actuators

Actuators are components that convert energy into mechanical motion in order to move or control a mechanism or system

Sensors

A sensor is a device that detects changes in electrical, physical or other quantities and thereby produces an output, as an acknowledgement of the change in the quantity.

Brushless Motor

Motors with permanent magnets that rotate around a fixed armature. Brushless motors are more efficient and harder than brushed motors.

LiPo Battery

Short for Lithium Polymer, LiPo is the type of battery favored by most drone manufacturers due to its low weight and maximized charge capacity and power.

Headless Mode

Regardless of the orientation of the craft or the way the front of the craft is pointed, it will follow your stick movements.

GCS

Ground Control System: Software which runs from a computer on the ground. It tracks and receives telemetry from the airborne UAV and displays its status and progress. It can also be used for transmitting in-flight commands up to the UAV in the air.

NOTAM

The acronym “NOTAM” stands for “Notice to Airmen”. NOTAMs are informational advisories filed with the Federal Aviation Administration (FAA) to give pilots and remote pilot operators notice of any potential hazards that could affect the safety of their flight.

FPV

First Person View. The drone is wirelessly controlled by the pilot through use of a screen or mobile device. You see what the drone sees.

RTH

A safety feature that allows the drone to autonomously fly back to the pilot's location and/or starting point.

GNC

Guidance, navigation and control. Several methods are used for GNC. Such as:

- INS- Inertial Navigation System
- GPS- Global Positioning System
- RC- Remote Control
- Autopilot- Preset Flight Path
- FCV- First Person View
- BCI- Brain Computer Interface

Part-107

The FAA Part 107 is a set of rules for operating a drone commercially (i.e. flying a drone to make money) in the U.S. It is also used to refer specifically to the certification drone pilots must have before they can legally offer professional drone services.

R/C

A radio-controlled aircraft (often called RC aircraft or RC plane) is a small flying machine that is controlled remotely by an operator on the ground using a hand-held radio transmitter.

Trim

Trim Buttons on the remote control that help you adjust roll, pitch, yaw, and throttle if they are off balance.

Roll

Basically, roll refers to the movement of the drone forward, backward, left and right along a horizontal axis.

Pitch

Pitch simply describes movement up and down along the vertical axis from the front to the back of the drone.

Yaw

Yaw is simply defined as the rotation of a UAV with respect to the center axis. If you were looking down on a drone from above, yaw refers to the movement of the drone clockwise or counterclockwise.

Throttle

Throttle controls the vertical up and down motion of the drone. Positive throttle will make the drone fly higher and negative throttle will make the drone fly lower.

Calibration

Calibrating a drone or a controller is the process of setting or correcting errors which caused inaccurate sensor measurements. It checks adjust or determine by comparison with a standard model and to make corrections accurately.

Tx

In electronics and telecommunications, a Transmitter (Tx) or radio transmitter is an electronic device which produces radio waves with an antenna.

BVLOS

BVLOS (Beyond Visual Line of Sight) is a term relating to the operation of UAVs (unmanned aerial vehicles) and drones at distances outside the normal visible range of the pilot.

VLOS

Visual Line of Sight Rules (VLOS) apply to small unmanned aircraft in the same way that Visual Flight Rules (VFR) apply to manned aircraft.

Multirotor

Multi Rotor drones are the most common types of drones which are used by professionals and hobbyists alike. Multi-rotor drones can be further classified based on the number of rotors on the platform, such as:

- Bicopter- 2 rotors
- Tricopter- 3 rotors
- Quadcopter-4 rotors
- Hexacopter- 6 rotors
- Octocopter- 8 rotors

Telemetry

Telemetry is used to retrieve flight information of your drone on your computer or your radio control in order to follow several parameters of your aircraft on the ground.

UAS/RPAS

Unmanned Aircraft (or Aerial) Systems (UAS) are any aircraft without a human pilot onboard and the associated systems. A UAS consists of the unmanned aircraft (UA) or unmanned aerial vehicle (UAV) and all of the associated support equipment, including the control station, data links, telemetry, communications and navigation equipment, etc. necessary to operate the unmanned aircraft. UAS are also known as RPAS: Remotely Piloted Aerial System. The major component of UAS is the UAV itself. Here's some more abbreviation you should know:

- UAV- Unmanned Aerial Vehicle
- MAV- Micro Air Vehicle
- NAV- Nano Air Vehicle
- PAV- Pico Air Vehicle
- MALE- Medium Altitude Long Endurance
- HALE- High Altitude Long Endurance
- LASE- Long Altitude Short Endurance
- LALE- Long Altitude Long Endurance

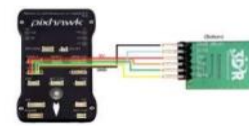


Drone Telemetry with Couchbase Mobile

Onboard Electronics

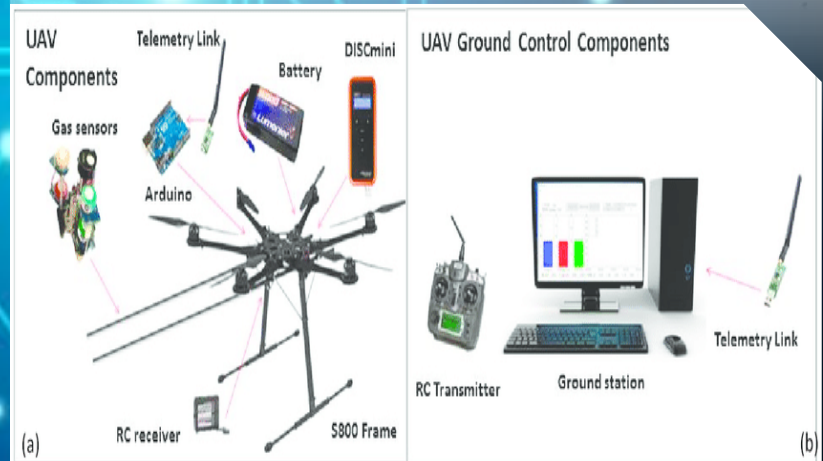


Sensor Controller



Flight Controller

Phone



The Big Question

Where you want to go with the pursuit of drone flying?

I am guessing you are a drone hobbyist curious about what opportunities are out there for drone pilots?

Maybe you are thinking of building your career in Drone Industry. First of all, let me give you a very good news, there are likely to be plenty of drone-related jobs available in the coming years. According to a 2013 report from AUVSI around 100,000 new jobs will be created in the first 10 years after drone's start being used for commercial purposes from 2006.

So, as you can see this new field of technology created an enormous job field for anyone capable of flying a drone. What you just need is register yourself for evaluation test and then get the drone license to start earning money and shine your career. Also, if you are not interested in being pilot even then you have options for becoming engineer or doing business.

But if you don't want career in UAV field you can remain as a hobbyist and fly for fun but check out these options below to set your mind. Of course, you won't miss this chance if your favorite hobby gives you a way of making money.



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About the Book:

Hope this book helped you to get a better understanding of unmanned aviation and nitty-gritty of drone technology and its future. You can share this book and upload anywhere without any internal modifications. If there's any suggestions or inquiries you have about this book don't hesitate to Email me at myinuiddin22@gmail.com. Finally, one advice, please respect others privacy and local flying rules while droning.



About the Author:



I am Myin Uddin Jubaid from Bangladesh. Currently I am staying in China for my BSc in Aeronautical Engineering at Shenyang Aerospace University. I am a creative content writer, poet and Astronomy enthusiast. I have my publications mostly in domestic magazines, newspaper and websites. Recently two of my coauthored poem books came out and this is my first published E-book.

Myin Uddin (الملک المعین)

Muslim & Bengali
Aerospace Engineer | A Cosmic Detective | Poet & Blogger

BG(O)-FM28
Edit

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Overview

Work and education

Places lived

Contact and basic info

Family and relationships

Details about you

Life events

Friends

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E = mc²
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General Theory Of Relativity (চলো সাধারন আপেক্ষিক তত্ত্ব নিয়ে জাতি)
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